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Title of the Paper Aerobraking at Venus and Mars

Appropriate Topic Experience from Current or Recent Missions
Alternative Topic Mission Planning, or Cost Efficient Operations

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Co-Author(s) none budget agreement in Congress.)

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Abstract Text: Aerobraking at Venus and Mars by Dr. Daniel T. Lyons

Aerobraking was successfully used to circularize the orbit of the Magellan spacecraft at Venus in 1993 as part of the extended mission. Plans have been made to use aerobraking to circularize the orbit of the Mars Global Surveyor spacecraft near the end of 1997 just prior to the start of the prime mission. Aerobraking is used instead of propellant to remove some of the energy from the orbit, which reduces the mass of propellant that must be launched into orbit. The smaller spacecraft mass means that a smaller, less expensive launch vehicle can be used to perform the same mission. The cost of the launch vehicle can be reduced by hundreds of millions of dollars by using aerobraking to provide some of the velocity change after arrival at Mars. All planned NASA missions to orbit Mars will use the aerobraking technique.

This paper will compare the similarities and differences between the completed Magellan aerobraking at Venus and the planned Mars Global Surveyor aerobraking at Mars. Since neither spacecraft is equipped with a heat shield, multiple passes through the atmosphere are used to shrink the orbit gradually. Both spacecraft require a drag pass attitude which precludes both communication with the Earth and collection of solar power, so the spacecraft must be reoriented several times each orbit before entering and after leaving the atmosphere. Although about 1200 m/s is removed in both cases, the orbital period for a Mars orbiter changes by more than 45 hours - requiring a change in the operational strategy partway through aerobraking, while the Venus orbiter period changed by less than 2 hours because the capture orbit period was 3.26 hours. The larger gravitational perturbations and the larger atmospheric disturbances at Mars will make aerobraking a very challenging experience for the very small and efficient flight team.